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been elected librarian of the Consolidated Libraries of New York, representing the Lennox Library, the Astor Library and the Tilden Bequest.

THE Botanical Library and the Herbarium of Columbia College, will be placed in a building to be erected in the New York Botanic Garden, and in return the privileges of the garden will be accorded to students of the College.

MACMILLAN & Co. announce that they will begin in September next a 'Garden craft series,' the first volume of which will be *Plant Breeding* by Professor L. H. Bailey.

THE *British Medical Journal* states that the question of founding a medical faculty in the University of Odessa, which had been long under discussion, has finally been decided in the affirmative. The municipality of Odessa has generously offered to double its grant for the new faculty, raising it from 250,000 to 500,000 roubles, that is, to over \$250,000.

THE opening article in *Appleton's Popular Science Monthly* for January is a description of the origin of the Smithsonian Institution by Dr. H. Carrington Bolton. The author describes Smithson's curious career, but scarcely attempts to assign his reason for making the United States his residuary legatee. The article reviews the formation and growth of the institution, and a second article will consider its present status and many activities.

THE election of officers of the Binghamton (N. Y.) Academy of Science, held on the afternoon of January 4th, resulted as follows:

President, PROF. E. R. WHITNEY (re-elected).

Vice-President, PROF. HERBERT J. JONES (re-elected).

Recording Secretary, WILLARD N. CLUTE (re-elected).

Corresponding Secretary, BURT E. NELSON.

Treasurer, JOSEPH K. NOYES.

A reception was tendered the members in the evening by the Young Women's Christian Association at their rooms in the Strong Building.

A NEW Russian journal, a *Review of Psychiatry, Neurology and Experimental Psychology*, edited by Dr. Bekhteret, will hereafter be published monthly.

THE deaths are announced of Cavaliere Dr. Alfonso Ademello, sanitary director of the hospital of Grosseto, and known for his excavations at Grosseto and for his writings on the Maremma, of Dr. Sickenberger, professor of botany and chemistry in the medical high school in Cairo; of Dr. A. de Cerqueira Paito, professor of organical chemistry in Bahia, and of Dr. Paul Reis, professor of physics at Mainz.

UNIVERSITY AND EDUCATIONAL NEWS.

THE new catalogue of Harvard University shows the total number of instructors to be 366 and the total number of students 3,600. The students are distributed as follows: 1,771, College; 340, Scientific School; 285, Graduate School; 41, Divinity School; 465, Law School; 531, Medical School; 102, Dental School; 55, Veterinary; 15, Bussey Institute. The number of students is 310 greater than last year as compared with a gain of 134 for that year.

AFTER 1901 only college graduates will be admitted to the Harvard medical school. Johns Hopkins University is the only American University now making this requirement.

THE departments of Physics and Mechanical Engineering at Brown University have been materially improved by the removal of the work shops that formerly occupied the basement of the Wilson Physical Laboratory to a building recently constructed for their reception. The new building has thirty-six hundred square feet of floor space, and is well equipped with all the machinery necessary for thorough courses of instruction in practical metal and wood working. Of the rooms thus rendered available in the physical laboratory two are to be fitted out for high temperature and pressure investigations, two for an electrical engineering laboratory, and one for a drawing room for the department of civil engineering.

THE late Franklin Baldwin, of North Grafton, Mass., has made the following bequests to take effect on the death of his wife: Wellesley College, \$50,000 to found a chair in mathematics in memory of his daughter, Katie Emma Baldwin; Smith College, Northampton, \$12,000 for scholarships; The University of Vermont, \$10,000 for scholarships; Dartmouth College, \$6,000

for scholarships. The residue of the estate (some \$20,000) is left to Clark University.

DR. C. A. STRONG, associate professor of psychology in the University of Chicago, has been elected lecturer on psychology in Columbia College.

PROF. L. S. LUTHER, of Trinity College, Hartford, has been elected president of Kenyon College, Gambier, Ohio. Professor Theodore Stirling, the professor of natural science, has been during the last four years acting president.

PROF. THEODORE VON DER GOLTZ has been appointed professor of agriculture in the University at Bonn in the place of Prof. Dunkelberg, who has retired.

DISCUSSION AND CORRESPONDENCE.

QUATERNIONS.

EDITOR OF SCIENCE: The circular letter of Dr. Molenbroek and Mr. Kimura published in the issue of your journal for October 18th appears to me to be a distinct improvement upon their preceding letter published in *Nature* for October 3d. In the former letter they assume that Hamilton's Quaternions is a much more perfect method than it really is, and they affirm that the newer forms of vector theory invented by physicists are founded on definitions which are established by Quaternions, and are systems of notation rather than logical developments of a mathematical idea. They also advise the "many who are prejudiced against the calculus of quaternions and maintain the opinion that it is hard to understand and that it contains a great deal which is useless in addition to things immediately applicable" to "approach the calculus with proper care and meekness in the assurance that they will ere long rejoice in having at their disposal an instrument of research mightier far than they had the slightest notion of so long as they were in the domain of cartesian mathematics."

In recent years I have published a series of papers on Space Analysis, the express object of which is to unify and harmonize the several vector methods with one another and with the ordinary analysis. I exclude neither the idea of a vector nor the idea of a quaternion, and I do not attempt to make Nature simpler than

she really is by identifying ideas that are different though complementary to one another. I look upon vector-analysis not as an independent and rival plant, but as a development of the old tree of mathematical analysis.

The greatest impediments to the progress of the method of Quaternions are not prejudice and false opinion in those to whom it is presented, but rather imperfections, mistakes and errors in the method itself. Hamilton ought to be reverenced for what he did accomplish, but that ought not to blind us to what he did not accomplish. It is an error to identify, as Hamilton does, vectors with quadrantal quaternions. It is an error to confound, as Hamilton does, successive with simultaneous addition; for thereby he failed to discover the generalization for space of the Exponential Theorem and of Taylor's Theorem. It is a mistake to introduce, as Hamilton does, a new notation which has no relation to the established notation of trigonometry, or to adopt conventions which do not harmonize with the established conventions of analysis.

To the amended proposal for an 'International Association for promoting the study of Quaternions and allied systems of Mathematics' there is no room for objection; for it does not assume the perfection and finality of Hamilton's work, but rather invites to the development and study of vector-analysis in its broadest sense. It will, I hope, receive a favorable response from all who are interested in the development or the teaching of space analysis. It is inevitable that there should be diversity of notation and warm discussion of principles among the pioneers in this region, but inasmuch as all are zealous for the truth, the proposed association would accelerate the progress to definite decisions, and thereby smooth the way for the spread of this, the highest development of the art of algebra.

Messrs. Molenbroek and Kimura refer to the remarkable advance in Electrical theory. That advance has been due in large measure to the practical manner in which electricians have discussed the principles and definitions of their science, finally settling all definitions by an authorized Congress. Doubtless the proposed association would eventually accomplish an